September 1987

Utility Analysis: A New Perspective on Human Resource Management Decision Making

John W. Boudreau
Cornell University

Abstract

[Excerpt] What do Human Resource Management (HRM) decisions contribute to organizational objectives? Are the organizational investments in HRM programs (such as pay for knowledge, enhanced employee benefits, training, staffing, and employee involvement) justified by their returns? Since labor costs can exceed fifty percent of total operating expenses (Milkovich & Boudreau, 1988), are the human resources being managed with the same accountability, rationality and care as the plant, equipment and marketing resources? Is such management even possible with human resources, or are the "people issues" facing organizations simply too ill-defined and unpredictable to be managed systematically?

Keywords

CAHRS, ILR, center, human resource, HRM, investment, pay knowledge, employee benefits, training, staffing, employee, accountability

DRAFT: DO NOT QUOTE OR CITE WITHOUT AUTHOR'S PERMISSION

UTILITY ANALYSIS: A NEW PERSPECTIVE ON HUMAN RESOURCE MANAGEMENT DECISION MAKING

Working Paper 87-09

John W. Boudreau

This research was carried out with support from the U.S. Army Research Institute, contract SFRC #MDA903-87-K-0001. The view, opinions and/or findings contained in this chapter are those of the author and should not be construed as an Official Department of the Army policy, or decision.

Chapter to appear in L. Dyer (ed.), Human Resource Management: Evolving Roles and Responsibilities, ASPA/BNA Handbook of Human Resource Management, Vol. 1 (Washington: Bureau of National Affairs, 1988).

This paper has not undergone formal review or approval of the faculty of the ILR School. It is intended to make the results of Center research, conferences, and projects available to others interested in human resource management in preliminary form to encourage discussion and suggestions.

DRAFT: DO NOT QUOTE OR CITE WITHOUT AUTHOR'S PERMISSION

Introduction

What do Human Resource Management (HRM) decisions contribute to organizational objectives? Are the organizational investments in HRM programs (such as pay for knowledge, enhanced employee benefits, training, staffing, and employee involvement) justified by their returns? Since labor costs can exceed fifty percent of total operating expenses (Milkovich & Boudreau, 1988), are the human resources being managed with the same accountability, rationality and care as the plant, equipment and marketing resources? Is such management even possible with human resources, or are the "people issues" facing organizations simply too ill-defined and unpredictable to be managed systematically?

These important questions face any human resource manager, whether a line executive or a staff professional. Though most managers, and certainly most HR professionals, would readily agree that human resources are among the most important in terms of dollar expenditures and effects on organizational goals, the HRM function is often regarded as a "cost center" or as an "overhead budget item," with little systematic attention devoted to its contribution to organizational goals (especially its contribution to the financial performance of the organization). Indeed, the question of its contribution to corporate profit is still controversial enough to merit recent debate in a widely-read professional journal (Gow, 1985). It is difficult to imagine such a debate regarding the Finance, Marketing, Accounting, or Engineering departments.

With increased competition, and evidence from the U.S. and abroad that competitive companies manage their people differently, organizations are paying more attention to their HRM decisions. HR managers are finding it increasingly difficult to justify very large year-to-year human resource programs solely because they are "good for human relations," "being done by everyone else in the industry," or "done that way in Japan and Korea." Instead, the HRM function is being required to justify its existence and account for its contributions. And appropriately so, because the HRM function is a steward for the single largest resource in most organizations. Yet, how can a Personnel manager respond to top management's order to justify a million-dollar training program? What can a Personnel manager say when top management proposes cutting 30% of the HRM programs in an effort to reduce "excess overhead?" How can an HR manager justify <u>increasing</u> budgets for training and outplacement when the organization is reducing staff levels to cut costs?

Human resource management programs produce potentially lucrative returns even when budgets are tight, but because the costs of such programs are often quite visible, while their benefits remain unmeasured, decision makers may be tempted to "cut the overhead" without considering lost program benefits. In contrast, decisions about programs in other management areas (e.g., marketing, finance, accounting, and plant operations) often consider not only costs, but dollar estimates of program benefits as well. It is difficult to imagine an engineer proposing to spend a million dollars to develop a new production process, without explaining its effects on product quality or cost. Yet, million-dollar HRM programs are routinely made with little explicit consideration of their effects on product quality or cost. For example, the decision to train 1,000 employees can easily incur costs of $1,000 per trainee (considering course development, instructor time, travel and lodging), but training results often go unmeasured. Lacking a systematic analysis of the training program's returns, a top manager might form the impression that such a million-dollar HRM program is more expendable than programs in other management areas.

This Chapter explores cost-benefit (or utility) analysis, a decision-support framework that explicitly considers the costs and benefits of human resource decisions. Utility analysis provides formulas for computing the dollar value of human resource programs, but it is more than formulas. It is a way of thinking about HR decisions that makes facts, assumptions and beliefs behind decisions more explicit, systematic and rational. It supports human resource decisions even when information is unavailable or uncertain, translates statistics into useful decision information, and it helps determine when more information is or is not needed.

Though utility analysis models can be complex and detailed, this Chapter will emphasize their managerial implications. It presents several case studies, illustrating how utility analysis models have been developed to encompass progressively more realistic and complete HRM decisions. Though it will draw on sophisticated algebraic models (with citations to direct interested readers), algebraic formulas will be minimized to emphasize the findings and implications. The first section discusses the advantages of cost-benefit models compared to other decision systems. The second discusses general issues important to applying cost-benefit models to human resource decisions. The third section shows how utility analysis applies to programs affecting the existing stock of employees, using a training program as an example. The fourth section develops cost-benefit models for decisions affecting employee flows, using a case study to illustrate each model's contribution. The final section presents implications and conclusions.

Why Use Cost-Benefit Analysis for Human Resource Management Decisions?

Decision makers concerned with how to invest resources in HRM programs have several types of information available to support those decisions. Let us examine where cost-benefit (utility) analysis fits in.

Alternative Decision Systems

Costs. Organizations could make their human resource management decisions based on costs, attempting to minimize them. Costs are incurred in every human resource management activity, so reducing costs often means reducing the number or scope of human resource activities. Other typical cost-reduction techniques involve reducing presumably costly employee behaviors such as turnover (Cascio, 1987, Flamholtz, 1985). Of course, this is only half the picture. Reducing HR activities or presumably costly employee behaviors may cut costs, but it may also reduce organizational effectiveness. Human resource activities or employee behaviors that at first appear costly may actually enhance effectiveness, as occurs for example when turnover creates opportunities to hire highly-qualified employees, but a cost-focused decision system may fail to detect this.

Informally-defined benefits. Organizations might informally consider human resource management benefits without an explicit framework or system, but the sheer complexity of these benefits can lead to unsystematic shortcuts. For example, a recruitment program might be assessed in terms of filling vacancies, while a selection test might be assessed in terms of whether competitors use such devices, or whether it will be vulnerable to scrutiny by the regional Equal Employment Opportunity office. Lacking a systematic approach, the analysis may be dominated by unsubstantiated beliefs, personal influence or political power, and the decisions may not achieve organizational goals.

Cost or Head Count Ratios. Decision makers might calculate any of a variety of ratios designed to analyze HR costs or staff levels. For example, one might compute the ratio of total employees to HR staff employees, or the ratio of sales to HR costs, or the ratio of training costs to the number of trainees (Fitz-Enz, 1984). Such ratios are sometimes compared over time, or to other competing organizations. While they can be useful for directing attention to staff levels or costs, they provide no framework for interpretation or decision making. If your cost ratio is higher than last year (or higher than a competitor's), what decision does that suggest? Is it always bad to have high or rising HR staff-to-employee ratios or HR cost-to-sales ratios? Clearly, if the programs and activities provided in return for such cost or staff levels are producing high organizational returns, there is less cause for concern than if they are not. Thus, cost and head count ratios must be interpreted within a decision framework to be useful in guiding HR decisions.

<u>Audits</u>. The fourth approach involves auditing human resource activities (Mahler, 1979; Sheibar, 1974). Such audits can be quite systematic and detailed, and can demonstrate whether human resource programs are being implemented as planned. However, they provide only limited information because they may not address whether the plan was appropriate in the first place. It is little consolation to find that an ill-conceived program was implemented as planned and incurred costs at the budgeted level, or that it was applied to the projected number of employees. A decision system needs to address costs and benefits <u>before</u> the activities are implemented, as well as providing an evaluation framework after they have been implemented.

<u>Formal studies</u>. The fifth approach involves conducting formal statistical studies to determine the effects of human resource programs. Examples include validation studies reporting the statistical relationship

between test scores and performance ratings, and experiments comparing the statistical difference in output levels between groups receiving different training programs. However, statistics alone are often not very useful to human resource managers, who are less concerned with exploring theory than with determining how to invest their limited resources to achieve the greatest benefit. Rarely does a scientific study even mention dollar values, let alone report results in terms of investments and returns.

Fully-detailed cost-benefit analysis. The sixth approach involves a full-blown cost-benefit analysis. The organization would identify alternatives, draw up a list of all the factors to be considered for each alternative, measure the factors on a common scale (such as dollars), and then compute the benefits and subtract the costs to determine the overall net value of each alternative. The best alternatives, or those with net values (or returns on investment) exceeding a minimum standard, would be implemented. The problem here, of course, is that all of the decision factors cannot be evaluated precisely and with certainty. Moreover, measuring everything may be quite costly. Still, the cost-benefit approach has a good deal of merit, if only it could be efficiently applied.

Advantages of a Cost-Benefit System

A cost-benefit approach offers the following advantages compared to other approaches:

1. Explicitness. Identifying and evaluating costs and benefits makes the assumptions, beliefs and facts more visible to all. They can be discussed, questioned and corrected, thus reducing the chance that incorrect or counter-productive information will go undetected.

2. Consistency. Human resource decisions are complex. Without

a system, it is easy for HR managers and strategic planners to make some decisions based on one set of issues, and other decisions based on a different set. For example, recruitment programs may be chosen based on low cost and probability of filling vacancies (Rynes & Boudreau, 1986), while selection programs are chosen based on legal defensibility and tradition. Yet, these four factors are relevant to both decisions, and none of these factors reflects the productivity of those hired. A cost-benefit system encourages consistency by providing a list of factors to be explicitly considered before basing a decision on only a few of them.

3. Efficiency. A cost-benefit system promotes efficiency because it can be applied to many decisions. Once developed, the organization can spend less time re-inventing the wheel for each new decision. While each decision is unique and may require some unique analysis effort, organizing the most commonly-considered factors in a cost-benefit system frees resources to focus on the really unique factors. Moreover, a cost-benefit approach guides the use of information and information systems. By identifying the decision factors, a cost-benefit framework allows decision makers to set priorities in gathering and using information, as we shall see in the subsequent examples.

4. Communication. A cost-benefit system improves communication among decision makers because it offers a common "language" for decision making. The identified set of decision factors and the system for applying them allows HR managers and their staff to coordinate. It is not necessary to redefine the data gathering

task every time, so decision makers can devote more resources to making decisions rather than identifying and locating information. Moreover, because organizations are measured (at least in part) by how well they use dollar-valued resources to achieve goals, communication with other management functions is improved by cost-benefit information that is expressed in dollars. When HR decision makers express their contribution in the same bottom-line terms used by other management functions (such as Finance, Marketing, Accounting and Operations), cross-function communication (and perhaps credibility) may be improved.

Cost-Benefit Decision Systems in Human Resource Management

The principal drawback of a cost-benefit decision system is that all the costs and benefits cannot be measured precisely (indeed, some cannot be measured at all). It is impossible to quantify the variety of factors affecting decisions about human resource activities into a single dollar value that expresses their contribution to the organization. But, is this really what a decision system must do? It is certainly not the typical approach used in other management functions. Anyone who has tried to forecast the stock market or predict the sales of a new product realizes that Finance and Marketing are not exact sciences. Yet, these functions typically express their programs' effects in dollar terms. Their objective is to enhance decisions by focusing on the important factors, isolating the ambiguous or uncertain factors, and systematically and explicitly addressing potential risk and uncertainty.

Unfortunately, the simplifications typically adopted to address human resource decisions (such as focusing only on costs, adopting programs because of tradition, and ignoring human resource benefits because they are uncertain) can have undesirable effects. A cost-benefit decision system offers a way out of this bind. It too simplifies the decision situation, proposing a set of variables to describe human resource program consequences, but it also efficiently summarizes a great deal of important information about human resource programs in an explicit, consistent and systematic way. It does not require measuring everything. To the contrary, cost-benefit techniques can help to pinpoint important information, and thus reduce the effort necessary to gather information.

Applying Utility Analysis to Human Resource Decisions

Utility analysis is the term for a set of cost-benefit models originally developed by industrial psychologists concerned with selection, and recently extended to other human resource programs and decisions. "Utility" simply means usefulness, and the aim of the models is to predict, explain and improve the usefulness of different human resource management decisions.

Requirements for Utility Analysis

Utility analysis, like other decision systems, requires: (1) A problem, or the gap between what is desired and what is currently achieved; (2) a set of alternatives to address the problem; (3) a set of attributes, or the variables that describe the important characteristics of the alternatives (such as effects on productivity, costs, employee attitudes, etc.); (4) a utility function, the system used to combine the attributes into an overall judgment of each alternative's usefulness. Utility analysis is generally employed when the first two requirements are met. Given a set of alternatives, utility models suggest a set of attributes and a utility function for combining attributes into an overall usefulness value, usually expressed in dollars.

The Unit of Analysis: Human Resource Programs

Utility analysis models focus on decisions about human resource programs. A human resource program (sometimes called an "intervention" by industrial psychologists, or an "activity" by HR professionals) is simply a set of activities or procedures that affect human resource value. Examples include selection tests, training courses, recruiting techniques, compensation plans, and job redesign. Decisions about such programs provide a vital link between broader human resource strategies and the day-to-day operational decisions made by human resource managers.

Human resource programs are more specific than human resource strategies. Strategies address broader issues such as staffing levels, functional areas to emphasize, and appropriate organizational structures. But, strategy implementation requires decisions about human resource programs. For example, a strategy intended to increase manufacturing employee flexibility requires choices among competing programs in selection, training and job design.

At the same time, decisions about human resource programs encompass more than purely operational decisions about individual employees (such as which employee to hire, train, promote or reward). Each of these decisions occurs within the framework of human resource programs. For example, deciding which employee(s) to hire or promote requires a framework of programs generating a pool of job candidates (such as college recruitment or job posting) and programs that provide staffing information (such as selection tests or skill inventories).

What Makes a Human Resource Program Useful? Quantity, Quality and Cost

Decisions about human resource programs have wide-ranging effects, subject to the scrutiny of many constituents. No decision system encompasses all of these effects, but utility analysis focuses on three important factors: quantity, quality and cost. HR programs have value when they affect many employee work behaviors over time, when they produce large improvements (or avoid large reductions) in the quality (or value) of those work behaviors, and when they minimize the costs required to develop, implement and maintain the programs.

These three factors are similar to those typically used in other management functions, and this similarity is not accidental. Marketing, Finance and Manufacturing Operations' programs also produce value to the extent that they produce large quantities of productivity (such as sales or units produced), large improvements in productive quality (such as reduced costs or increased quality), and minimize the necessary cost or investment. The utility analysis models presented in this chapter reflect the similarities between investing resources in human resource management programs and investing resources in programs from other management areas.

In considering quantity, quality and cost, it is important to recognize that different constituents may be concerned with different aspects of these three factors. For example, operating managers may be concerned with the program's effects on unit revenues and operating costs in the short run (perhaps because they expect to be promoted shortly), while the financial and accounting staff may be concerned with the programs' impact on the unit's financial statements, and top management may be more concerned with enhancing the long-term flexibility and productivity of the work force. Utility analysis can reflect these different perspectives, but each one implies a different way of measuring program payoff.

Utility analysis must also identify the mechanisms through which HR programs affect the organization. For example, organizations facing increasing product demand use enhanced employee productivity to increase output, while organizations facing cost pressures apply productivity improvements to reduce head count and compensation costs. Again, utility analysis can encompass each of these effects, but the analyst must carefully define and measure the payoff to reflect the appropriate effect. A common mistake in utility analyses is to measure whatever outcomes are convenient (e.g., sales or absenteeism) even when such outcomes have little relevance to organizational goals.

Utility analysis models clearly omit some decision factors. They emphasize productivity-related outcomes, and ignore other potentially important factors such as employee attitudes, union relationships, government or public relations, and political considerations. They represent one valuable decision support tool in the arsenal of HR decision makers. They do not provide the answers to all human resource decisions any more than a financial analysis alone fully addresses the decision about whether or not to build a nuclear power plant. Utility analysis models are useful because they summarize a great deal of productivity-related information so that it can be compared to these other important factors.

What if We Can't Measure It? Precision in Utility Analysis

Though utility analysis models are all based on three simple concepts of quantity, quality and cost, they are nonetheless complex. This complexity can give the incorrect impression that utility analysis is impractical. Some of the variables cannot be measured precisely (or cannot be measured at all). Those that can be measured are often uncertain and prone to change over time or in different situations. Finally, some variables that could be measured precisely are simply very expensive to measure.

These considerations are legitimate and important, but measurement limitations and uncertainty should not prevent systematic analysis of human resource programs any more than uncertainty about stock prices or the inability to precisely measure consumer preferences prevents systematic analysis of financial investments or marketing strategies. The limitations and costs of information are quite well recognized in management, and there are ways to address these problems (cf. Bierman, Bonnini & Hausman, 1981, Chapters 4-10). Simply put, information is useful when it: (1) is likely to correct decisions that would have been incorrect without it; (2) when the corrections are important and produce large benefits; and (3) when the cost of the information does not outweigh the expected benefit of the corrected decisions.

In other words, information gathering is itself an investment decision. Uncertainty about human resource program effects should lead decision makers not to abandon systematic analysis, but to use methods that identify the sources of uncertainty, how (or whether) it affects decisions, and when to invest in better information. This approach differs from common practices that focus only on the most measurable information, such as costs, or base decisions on inexplicit beliefs or opinions. Subsequent sections will illustrate how utility analysis models make human resource decisions more systematic even in the face of uncertainty.

Two Categories of Human Resource Management Programs and Effects

The concepts noted above (costs and benefits; human resource programs; quantity, quality and cost) can be applied to all human resource program decisions, but the analysis differs depending on whether the program affects employee stocks or flows.

Employee stocks. Programs affecting employee stocks (such as training, compensation, performance feedback and employee involvement) aim to increase valuable characteristics (such as skills, abilities or motivation) among existing employee to improve their current job performance. In terms of quantity, quality and cost, decisions affecting employee stocks enhance productivity more when they: (1) Affect large stocks of employees and time periods; (2) Cause large average increases in the value of employee job behaviors; and (3) Achieve 1 and 2 at minimum cost. Thus, decisions affecting employee stocks "work" by improving employee behaviors in their existing assignments.

Employee flows. Employee flows occur when employees move into, through and out of an organization through selection, separation, promotion, demotion and transfer. In terms of quantity, quality and cost, decisions affecting employee flows enhance productivity more when they: (1) Affect large numbers of employee flows and time periods, (2) Achieve large increases in the value of job behaviors by making better person-job matches, and (3) Achieve 1 and 2 at minimum cost. Most research has focused on utility analysis for selection decisions, but the approach applies as well to other programs affecting employee flows (such as improved recruitment, job posting, or incentives that encourage employees to apply for jobs or promotions). Programs affecting employee flows "work" by improving the pattern of movements into, through and out of the organization so that more valuable employees are placed in jobs or work roles.

Utility Analysis for Decisions Affecting Employee Stocks

Utility models have been applied to performance feedback (Florin-Thuma and Boudreau, in press; Landy, Farr & Jacobs, 1982) and training (Mathieu & Leonard, 1987; Schmidt, Hunter & Pearlman, 1982). As noted, such models could also be applied to other programs affecting employee stocks (such as compensation and employee involvement). To illustrate utility analysis for such programs, let us examine the case of a large manufacturing organization faced with a choice between two training programs. Though disguised, this example is based on an actual utility analysis application conducted in 1986.

The Decision Situation

The decision involved a choice between delivering training for engineers through a traditional classroom system, or through a sophisticated audio-video network. While some training staff believed the audio-video system was a good investment, cost pressures had convinced others that it was simply too expensive. Table 1 describes the example in terms of quantity, quality and cost.

Insert Table 1 Here

Cost. The classroom program would cost $451,035 over five years, while building and staffing the audio-video network would cost $1,031,147 over five years (with the largest portion occurring in up-front costs). To be conservative and ensure no unfair advantage to the Audio-Video system, the entire cost of the system was borne by this one program, though if implemented many programs would share it.

Quantity. The target population for training was the 200 currently-employed engineers, plus 20 new engineers added every year for the next four years. Due to training capacity constraints, Classroom training could train only 40 employees per year, or 200 over the 5-year target period. Audio-Video training could accommodate up to 200 persons per year, thus it could fully train the incumbent work force in the first year, and then easily accommodate the additional 20 new hires in each future year, for a total of 280 trainees over five years.

Cost per trainee. Following its typical practice, the organization computed the accounting cost per trainee by dividing total costs by the number trained. Classroom training cost $2,255 per trainee (i.e., $451,035/200) and Audio-Video training cost $3,683 per trainee (i.e., $1,031,147/280). These figures suggested that Audio-Video training must demonstrate much higher per-trainee effectiveness than Classroom training to be cost effective. Discussions concerning whether this was likely had reached no definite conclusions. Some believed that spending over one million dollars on a training delivery system for 280 engineers could not possibly be cost-effective. Moreover, some believed that cost-benefit analysis required a costly and complex experimental study to discover the program's effects on performance.

Leverage Computation. Evaluating training programs solely based on cost-per-trainee is like evaluating a manufacturing plant based on the amount of raw materials it consumes, rather than on its production of finished goods. How much productivity would be affected by the two training programs? The number of trained engineers the programs would place into the work force over the five-year period is shown in the middle portion of Table 1 (because engineer tenure averaged more than 5 years, we assumed no turnover.) Because Audio-Video delivery trains more people earlier (e.g., the first 200 trainees are productive for the entire 5-year period), it affects 1,200 total person-years of productivity (i.e., 200 plus 220, etc.). Classroom training trains a total of 200 employees, but only 40 at a time, so the work force doesn't reach 200 trainees until Year 5.

Still, even Classroom training affects 600 person-years of productivity (i.e., 40 plus 80, etc.). This is the leverage of the two programs, and this leverage computation demonstrates how faster training can substantially increase the program's effect. Leverage occurs because human resource programs affect many employees who affect productivity for a long time.

Quality. Typical of many organizations, little information was available to help us estimate the effects of the two training programs on employee quality, and certainly none that could forecast the dollar value of improved performance. To explicitly symbolize this uncertainty, the unknown average productivity increase per-trainee, per-year was simply symbolized P_1 for Option 1 (Classroom Training) and P_2 for Option 2 (Audio-Video Training).

Payoff formulas. Even without knowing the effects of either program on employee quality, the cost and leverage information proved quite useful in constructing the payoff formulas shown in Table 1. The utility (usefulness) of Classroom training (i.e., U_1) goes up by $600 with every one-dollar increase in average employee quality per person-year, offsetting the $451,035 cost. Similarly, the utility of Audio-Video training (i.e., U_2) goes up by $1,200 for every one-dollar increase in average employee quality per person-year, offsetting its $1,031,147 cost. These payoff functions suggested that quite modest program effects might be sufficient to make training worthwhile and that large training effects on employee value would produce quite sizable returns to the training investment. For example, an average productivity increase of $1,500 per person-year would produce total utility of $148,965 from Classroom training and $168,853 from Audio-Video training. This represents a 33% return on investment for the Classroom training, and a 16% return on investment from the Audio-

Video training. At higher average productivity increases, the relative advantage of the Audio-Video training is enhanced.

Break-Even analysis. Of course, the $1,500 figure used above was only a guess. As noted, little information was available to precisely estimate the dollar increase in employee value per person-year from either training program. However, rather than embark on potentially costly studies attempting to measure this variable, we divided the costs by the leverage to obtain the values for P_1 and P_2 that would cause each program's total payoff to equal (or "break-even" with) its costs. These values are shown in Table 1. The Classroom training costs would be covered if it produced at least $752 per person-year (i.e., $451,035/600), while the break-even value for the Audio-Video training program was $860 per person-year (i.e., $1,031,147/1,200). Notice that these values are much lower than the costs-per-trainee computed earlier. Relatively modest training effects could justify what had originally appeared to be a very large necessary training investment.

Program comparisons. While the break-even analysis was enlightening, it treated each training option independently, and therefore did not address the question of whether to substitute the more expensive Audio-Video training for the less expensive Classroom training. However, the same break-even logic could be applied to this question. What are the values of the unknown Classroom training effect (i.e., P_1) and Audio-Video training effect (i.e., P_2) that would make the total utility of Audio-Video training equal to Classroom training? The formula for these relative effects is found by subtracting the Classroom payoff formula from the Audio-Video payoff formula, producing a payoff formula reflecting the difference between the two programs as shown in Table 1. By setting the difference (U_2 -

U_1) to zero, we obtained a formula for the value of P_2 that would be necessary to make the Audio-Video program payoff exactly equal to the Classroom program payoff, given a certain value for P_1 [i.e., $P_2 = (.5 \times P_1) + \$484$]. The decision rules implied by this break-even analysis are shown at the bottom of Table 1. For example, if the payoff per person-year from Option 1 (P_1) is equal to $2,000, then the payoff per person-year from Option 2 (P_2) must exceed only $1,484 [i.e., (.5 X 2,000) + 484] to justify the more expensive Audio-Video training. If Classroom training produces large productivity increases (i.e., greater than $968 per person-year), it can be cost-effective to invest in the faster Audio-Video training system <u>even if it has a smaller average productivity effect per person-year</u> than Classroom training. The break-even formula provides a simple equation that shows when each program is the better investment. Moreover, the computations can be further simplified using personal computers (Boudreau & Milkovich, 1988, Chapter 8).

<u>Decision Results</u>. Even without measuring training effectiveness, the break-even analysis focused the decision process and helped to better define the critical issues. Instead of arguing about whether one or another estimate of training effects was right or wrong, the decision focused on whether the Audio-Video training effect was enough to justify switching to it. In light of the important work done by these engineers, and the undisputed value of this training for engineering performance, the Audio-Video expenditure could be justified. Moreover, because other training programs could also use the Audio-Video network, the fact that it could be justified for this program alone made it a worthwhile investment. The break-even analysis demonstrated that a costly and complex effectiveness study (earlier thought to be essential for applying cost-benefit analysis)

was not necessary to improve decisions.

This example demonstrated how the utility analysis concepts of quantity, quality and cost can be applied to training programs. Similar applications are possible for other programs affecting employee stocks, such as compensation and employee involvement. Moreover, it demonstrated how an explicit cost-benefit analysis can address uncertainty about program effects. Uncertainty is a fact of decision making. Break-even analysis is one method of addressing uncertainty explicitly, and reducing its detrimental effects on decision quality. Rich and Boudreau (1987) demonstrated several other methods of addressing uncertainty when cost-benefit analyses are applied to HRM decisions. We now discuss how to apply these cost-benefit principles to decisions affecting employee flows.

Utility Analysis for Decisions Affecting Employee Flows

Analyzing the costs and benefits of programs that affect employee stocks is useful, but what about employee flows? How can we determine whether resources devoted to improve selection tests, college recruiting, turnover/layoff management, and internal staffing offer sufficient returns to justify their expense?

As noted earlier, employee flows occur when people into, through and out of organizational positions/jobs (e.g., selection, turnover, promotions, demotions and transfers). HRM decisions affect such flows as well as affecting the existing stock of employees. However, decisions that affect employee flows operate differently. Whereas decisions affecting employee stocks work by enhancing the value of employees in their current positions, decisions affecting employee flows work by affecting which individuals will occupy those positions.

We can consider three general processes through which individuals flow through the work force (Boudreau & Berger, 1985b; Milkovich & Boudreau, 1988, Ch. 10-13): (1) External recruitment/selection, which involves attracting a pool of job applicants and choosing which of them will be hired into the organization; (2) External separation/retention, which involves managing the quantity and pattern of employee separations that affect which employees are retained by the organization; and (3) Internal staffing, which involves managing the quantity and pattern of employee movements between positions within the organization. Though these processes are typically managed, evaluated and planned as if they were independent, they are obviously quite closely related. Effectively managing each of them depends on the quantity, quality and cost effects of HRM programs that identify candidates for employment opportunities, that choose which candidates will fill employment vacancies, and that affect who stays and leaves the job.

Insert Table 2 Here

The following section develops utility models for decisions affecting employee flows. The models proceed from simpler to more complex. The first models focus solely on external selection, with subsequent models adding enhancements to reflect and integrate the other employee flow processes. Table 2 provides a summary of the decision models, the features added by each one, and the decision addressed by each model. Model #1 focuses on choosing whom to hire from among one group of external job applicants. Model #2 incorporates factors useful in making HRM decisions compatible with the financial considerations typically applied to other investments. Model #3 extends the model to reflect the effects of re-applying selection programs over time. Model #4 incorporates the effects of recruitment into the external staffing utility analysis. Model #5 incorporates the effects of employee separations (e.g., turnover, layoffs, resignations) into the recruitment-selection utility analysis. Finally, Model #6 incorporates the effects of internal employee movements (e.g., promotions, demotions and transfers) into the analysis, providing an integrated analysis framework for the staffing process. Thus, Table 2 provides an outline and summary for the discussion that follows.

The Case Study Decision Situation

We will explore utility models for employee flows using a case study. Though hypothetical, this case study uses information based on published studies and realistic assumptions. However, readers may find it useful to substitute values from their own experience to produce illustrations that are more familiar to them. The important point is not the numbers themselves, but the decision systems they illustrate. Throughout the analysis, break-even analysis will be used to illustrate how uncertainty can be explicitly and systematically addressed. Readers should also keep in mind that though the computations behind the models can become complex, computer analysis methods (e.g., Boudreau, 1985, 1987a) greatly reduce the computational burden.

Insert Table 3 Here

Consider a large organization employing 4,404 entry-level computer programmers, and 1,000 data system managers one level above them. Table 3 contains a description of the characteristics of the two jobs (adapted from Schmidt, Hunter, McKenzie and Muldrow, 1979 and Boudreau, 1987b).

Currently, 618 programmers leave the entry-level job each year and are replaced by 618 new hires. The organization experiences 100 separations per year in the upper-level data system manager job, and has a promotion-from-within policy. Thus, 100 employees are promoted from the entry-level computer programmer job to fill the vacancies. An additional 100 new hires fill the entry-level vacancies in the programmer job created by these promotions, bringing the total number of new hires per year to 718.

Human resource managers in this situation are called upon to make decisions about how employees are selected, how they are recruited, how their turnover should be managed, and how they move between the two jobs. How can managers determine whether the outcomes of these activities provide sufficient returns to justify organizational investments? How much additional investment could be justified? How should resources be allocated between activities such as recruitment, external selection and internal staffing? To illustrate how utility analysis addresses issues like these, we will consider four questions:

1. Should the current employment interview be augmented by an ability test?
2. Should the recruitment program be changed to attract higher-quality applicants?
3. Should the pattern of employee separations be changed to retain more of the good performers, and how much would such a change be worth?
4. Should an assessment center be used to promote programmers to system managers, and how much would such a program be worth?

Utility Analysis for Employee Selection

The first strategic question addresses the method used to select new employees into the Programmer job: "Should the current employment interview be augmented by an ability test?" Selection test development and validation can be an expensive and time consuming process, and human resource managers may be called to justify such costs. Several models have been proposed to address this question.

Preliminary Attempts to Develop Selection Utility Models

Utility analysis models for selection enjoy a long history, but it was only recently that they reflected dollar values. However, understanding the early utility models shows why researchers and managers were compelled to develop utility analysis models for selection. More detailed summaries of these early models can be found elsewhere (e.g., Boudreau, in press; Cascio, 1987, Hunter & Schmidt, 1982; Milkovich & Boudreau, 1988).

The earliest index of selection value was the correlation (or validity) coefficient, which is a statistical measure of the linear relationship between scores on a selection device (called a predictor) and subsequent performance levels. The validity coefficient ranges from -1.0 to +1.0, with zero indicating no linear relationship and higher values indicating stronger positive linear relationships. The correlation coefficient reflects one aspect of a test's value, but it says nothing about the quantity of employees and time periods affected, fails to reflect any tangible quality index (such as dollars), and ignores testing costs.

A second index of selection usefulness originally proposed by Taylor and Russell (1939) was the "success ratio," or the probability that someone achieving a passing score on a predictor would turn out to be at least minimally successful on the job. Under certain assumptions, the success ratio is improved by higher validity coefficients, by setting higher passing scores on the predictor (e.g., being more selective), and when only about half of the applicant pool would be successful if hired without the predictor. Though the success ratio incorporates more factors than simply validity, it has limited value as a cost-benefit index because it ignores the quantity of employees and time periods affected, and it ignores testing costs. Moreover, the success ratio distinguishes only between those who achieve minimally acceptable performance on the job, and those who do not.

Model #1, The One-Cohort External Selection Utility Model

These early models laid the foundation and highlighted the need for selection utility models that present the value of selection investments in more tangible units (preferably dollars) and reflect the fact that job performance doesn't simply fall into two categories, but varies widely. Let us return now to our case study to examine more recent utility analysis models that address these issues.

How the utility model works. The first utility analysis model focuses only on one group (or "cohort") of employees hired with the new test, using the Brogden-Cronbach-Gleser (B-C-G) utility model (Brogden, 1946a, 1946b, 1949; Brogden & Taylor, 1950; Cronbach & Gleser, 1965). In this model, the quantity of person-years of productivity affected by a selection system is equal to the size of the hired group multiplied by their average tenure. The quality produced by the new selection system is the difference in average dollar-valued productivity per-person, per-year between those selected with the new system and those who would be selected without it. The cost of the selection program is equal to the additional costs incurred to develop (or acquire) the new selection device, and to apply it to one group of job applicants.

Quality is the product of three factors: (1) the validity coefficient (or the difference between the validity coefficient of the proposed selection system versus that obtained without it) reflecting prediction accuracy; (2) the average standardized test score of those selected (reflecting how selective the organization is), which can be estimated using standard tables (Naylor & Shine, 1965); and (3) the "dollar value of a one-standard-deviation improvement" in new-hire value. This term can be called the SD of Applicant Value (usually symbolized as $\underline{SD_y}$), because it reflects the dollar value to the organization of obtaining applicants whose average performance is one standard deviation higher than other applicants.

$\underline{SD_y}$ measurement controversy. The SD of Applicant Value ($\underline{SD_y}$) has become a controversial topic in industrial psychology, and requires some explanation. This variable is necessary because the utility model based on the validity coefficient expresses both the selection test score and the value of job behaviors predicted by the test in standard deviation units. In the quality computation described above, the product of the validity coefficient and the average standardized test score equals the difference in productive value in standard deviation units between applicants selected with the device and those selected without it. To translate the standard deviation differences into dollars per person-year, they are multiplied by $\underline{SD_y}$ which represents the dollar value of a one-standard-deviation performance difference per person-year between applicants. In general, we would expect $\underline{SD_y}$ to be larger when job performance is greatly affected by individual differences (e.g., when managers have great discretion over how they carry out their jobs and make decisions), when the consequences of those decisions are important (e.g., when employees handle expensive raw materials), and when the distribution of job-relevant characteristics is very large in the applicant pool (such as when the pool of applicants for a managerial job contains recent college graduates as well as experienced former managers).

Most utility analysis research by psychologists compares different SD_y measures. Some (e.g., Schmidt, et al., 1979) have measured it by surveying supervisors of the job, asking them to estimate the value of a person who is better than 95% of the population, a person who is better than only 50% of the population (an average performer), and a person who is better than only 15% of the population. Under certain assumptions, the difference between the estimate of the 95th and 50th percentiles, and the difference between the estimate of the 50th and 15th percentiles should be the same, and should represent the value of a one-standard-deviation difference. Others (e.g., Schmidt & Hunter, 1983) have estimated it as 20% of average productivity, or 40% of average salary among job incumbents. Still others have adopted detailed and complex methods based on behavioral anchors (e.g., Cascio & Ramos, 1986). Boudreau (in press) reviewed this measurement research, and found that different measurement techniques did indeed produce different SD_y values, but none offered a convincing case for greater accuracy or validity. Considering the difficulties in measuring job performance differences between existing employees on any scale, it seems unlikely that we will soon discover a generally-accepted measure of dollar-valued performance differences among job applicants. As we shall see, however, this limitation does not threaten most utility analysis applications.

Insert Table 4 Here

Application to the case. Let us assume that the organization is considering using a paper and pencil test of programming ability, the Programmer Aptitude Test (PAT) to select programmers. Table 4 shows the information needed to apply the one-cohort selection utility model. The model focuses on one cohort and one job, so we focus on the consequences for selecting 618 computer programmers. Costs equal $12,360, calculated by multiplying the cost of testing each applicant (i.e., $10) by the number of applicants tested (1,236). The quantity of employees and time periods is calculated by multiplying the average tenure (9.69 years) by the number selected (618) to produce 5,988 person-years. The quality per person-year is the product of the increase in average standardized test score compared to random selection (i.e., .80 with a 50% selection ratio, from the Naylor-Shine tables) times the validity coefficient (.76, estimated from previous studies) times the dollar value of a one-standard-deviation difference between job applicants (calculated by Schmidt, et al. to be $10,413 per year), which equals $6,331 per person-year. To simplify this analysis, we assume that .76 represents the increase in validity obtained by using the PAT versus not using it (i.e., not using the PAT results in essentially random selection). Of course, the models can easily be modified to reflect comparisons between two selection systems with different validity.

Utility computation. Multiplying quality (i.e., $6,331 per person-year) by quantity (i.e., 5,988 person-years) produces an estimated benefit of $37,910,028 for the 9.69 years. Subtracting testing costs of $12,360 produces increased utility of $37.9 million more than random selection, as shown in Table 4. The $37.9 million divided by the $12,360 increased testing costs represents a return of 306,634 percent! Not surprisingly, these results caught the attention of psychologists and some managers because they were much higher than most people would have suspected.

Dealing with uncertainty. These values certainly do not represent a perfect prediction of the dollar value of selection. Many of the parameters represent estimates, and thus contain various sources of bias, uncertainty and error. However, as the break-even analysis of Table 1 showed, uncertainty should not prevent applying decision models. We can apply break-even analysis to this example as well. Considering the controversy surrounding measures of SD_y, we might expect uncertainty and skepticism about its value. We can re-write the payoff function leaving this parameter unknown:

$$\text{Utility} = (3{,}641 \times SD_y) - \$12{,}360 \qquad (1)$$

Dividing $12,360 by 3,641 gives the value for SD_y that would make benefits exactly equal costs (and total utility exactly equal to zero). This value is $3.39 per person-year, and is the lowest value for SD_y that would still justify the testing costs. Hiring superior applicants may be valued because it increases the amount of work, the quality of work, or allows the same work to be accomplished with fewer programmers. While many might argue that Schmidt, et al.'s value of $10,413 may be too high, it is difficult to imagine that a one-standard-deviation difference in value (e.g., the difference between a superior programmer applicant and an average applicant) would be less than $3.39 per year. Thus, break-even analysis shows that the wisdom of investing in improved selection is not uncertain, only the magnitude of the positive returns to that investment.

Break-even analysis can address even greater uncertainty. Suppose we doubted that using the PAT would increase selection validity by .76, and that our selected applicants would attain an average standardized test score of .80 (which assumes that the top 50% of applicants will receive and accept job offers). Neither of these parameters is without scientific controversy (Sackett, Schmitt, Tenopyr & Kehoe & Zedeck, 1985; Schmidt, Hunter, Pearlman & Hirsh, 1985; Boudreau & Rynes, 1985). We can symbolize the unknown effect on quality as QUAL, and re-write the utility formula in terms of quantity (i.e., 5,988 person-years) and cost (i.e., $12,360):

$$\text{Utility} = (5{,}988 \times \underline{\text{QUAL}}) - \$12{,}360 \tag{2}$$

The value for QUAL at which the testing benefits break even with the testing costs is $2.07 per person-year (i.e., $12,360/5,988). The question boils down to whether using the PAT instead of selecting randomly will improve selection decisions enough to raise the value of those selected by an average of at least $2.07 per year (over 9.69 years).

Finally, consider the possibility that testing costs are uncertain. Suppose we felt they might be as high as $1,000 per applicant rather than $10, implying a total testing cost of $1,236,000. We could re-write Equation 2 to reflect this as follows:

$$\text{Utility} = (5{,}988 \times \underline{\text{QUAL}}) - \$1{,}236{,}000 \tag{3}$$

The break-even value for QUAL is increased by 100 times to $207 per person-year (i.e., $1,236,000/5,988). Thus, even if costs are 100 times higher than expected, they will be offset by rather modest selection effects per person-year. This occurs because of the large leverage (i.e., 5,988 person-years) affected by this selection program.

Model #2: Financial One-Cohort External Selection Utility Model

The previous analysis provides a systematic framework that focuses attention on selection costs and benefits. One consequence of such a focus, however, is that it draws attention to the financial implications of human resource investments. Line managers and those in other functional areas (such as Finance, Accounting and Marketing) frequently incorporate financial factors not usually considered by human resource managers. What are the tax implications of increased productive value? Wouldn't hiring superior programmers require higher costs to attract and retain them? Is it appropriate to value productivity increases obtained next year equal to productivity increases obtained up to 10 years from now? Human resource managers unprepared to address such questions may find that their cost-benefit numbers lack credibility or even lead to incorrect conclusions (Boudreau, 1983a; Cronshaw & Alexander, 1986). The next utility model addresses these financial considerations.

How the utility model works. Financial analysis typically adjusts future projections of revenue and costs to reflect: (1) productivity increases that enhance the value of goods sold (i.e., "service value") often require increased "service costs" to maintain those productivity increases, in addition to the direct costs of the productivity improvement program (e.g., increased sales may require increased inventories and increased sales commissions); (2) benefits received and costs incurred in the future are worth less than today's benefits and costs, because benefits received (or costs incurred) today can be invested earlier to earn more interest than those received later (this interest rate is called the "discount rate"); and (3) increases in organizational profits that are subject to income taxes carry an obligation to pay some of the increased profit to Federal, State or Local governments. The Financial One-Cohort External Selection Utility Model (Model #2 in Table 2) adjusts the estimate of program quality and cost to reflect these three factors.

Insert Table 5 Here

Application to the case situation. Table 5 applies these considerations to the utility values derived earlier. Necessary additional information includes the proportion of variable service costs (assumed to be 5% of the increase in productivity), the corporate tax rate (assumed to be 45%) and the corporate interest rate reflecting the yearly return that can be earned on investments (assumed to be 10%).

Utility computation. Applying these parameters (see Boudreau, 1983a for details) produces an adjusted utility value of $12.55 million as shown in Table 5. This is the after-cost, after-tax, discounted value of selecting one cohort with the PAT instead of randomly. For an after-tax testing cost investment of $6,798 (i.e., $12,360 times .55), the organization receives an after-tax return of $12.55 million in present-dollar terms. While smaller than the results of Model #1, this return remains substantial and may be more credible to those accustomed to financial analysis.

Dealing with uncertainty. We can rewrite Equation 2 to reflect the financial/economic factors shown in Table 5 as follows:

$$\text{Utility} = (1{,}983 \times \underline{\text{QUAL}}) - \$6{,}798 \qquad (4)$$

Where 1,983 reflects not only the quantity of person-years affected by testing, but also the variable cost proportion, the discount rate and the tax rate. This formula suggests that to justify the $6,798 after-tax testing cost, those programmers selected with the PAT must be $3.43 more valuable (i.e., $6,798/1,983) per person-year more than programmers selected randomly. This value is higher than the $2.07 value obtained in Equation 2, because we now recognize that the benefits of improved testing must offset not only testing costs, but also increased taxes, service costs and interest.

Model #2 can be used to explore uncertainty in the financial/economic factors themselves, though these variables are typically estimated by the organization's financial experts, and are relatively certain (c.f., Rich & Boudreau, 1987). The point is that break-even analysis allows uncertainty to be explicitly addressed within a financial framework just as it did when using the non-financial model. Note that these same financial factors can also be applied to utility analyses for decisions affecting employee stocks discussed earlier (see Boudreau, 1983a).

Model #3: Financial Multiple-Cohort External Selection Utility Model

Utility Models #1 and #2 reflect only the consequences of selecting one group of new hires (in this example, 618 programmers who stay on the job for about 10 years). Though the utility values are large, evaluating only the effects of the first group hired is like evaluating a new production plant based only on its first production run. Selection programs are typically re-applied to new groups of applicants for several years. Managers might well ask, "What's going to happen as we continue to spend money on this new testing scheme many years in the future?" Obviously, testing costs will increase as programs are re-applied. What may not be so obvious is that the leverage and potential benefits of selection programs also rise substantially as selection programs are re-applied. Model #3 in Table 2 designed to address these concerns (Boudreau, 1983b).

How the utility model works. In the multiple-cohort selection model, the selection program is re-applied for some chosen number of years. Thus, the costs of testing applicants are incurred in each future year, rather than only once in the one-cohort model. Each newly-hired cohort is assumed to stay for the some number of time periods and then leave. Thus, as the selection program is re-applied, the work force contains larger and larger numbers of better-selected employees. For example, assuming no one leaves during the first three years of a selection program, the first better-selected group is joined by a second better-selected group in Year 2, and still a third better-selected group in Year 3. The multiple-cohort selection utility model considers both the increased costs of applying the selection program for several years and the benefits derived from having more employees on the job. Moreover, it continues to reflect the financial considerations discussed earlier.

Insert Table 6 Here

Application to the case situation. Table 6 shows the results of applying Model #3 to the present case. The work force size, number of applicants, testing costs, number selected, number leaving, tenure, test validity and financial variables are assumed constant throughout the analysis. Thus, the PAT still costs $10 per applicant tested, and those selected with it are assumed to average $6,331 (i.e., $10,413 times .76 times .80) more valuable per person-year than if they were selected randomly. We assume the PAT is applied for seven years, that each hired cohort stays ten years, and that we evaluate the testing program for ten years.

In each of the first seven years, 618 better-selected new hires are added to the work force, replacing 618 employees selected without the PAT. Because each cohort stays for ten years, the number of better-selected programmers in the work force steadily increases. There are 618 better-selected programmers after one year. These are joined by another 618 in the second year for a total of 1,236. In Year 3 there are 1,854, and so on until Year 7, when 4,326 (i.e., 7 times 618) out of 4,404 programmers have been selected using the PAT, and we assume the selection program is ended. All of these 4,326 programmers stay for the remaining 3 years of the 10-year analysis. The increased leverage of the selection program is substantial. Over the 10-year analysis, selection affects 31,282 person-years of productivity (i.e., the sum of 618 plus 1,236 plus 1,854, and so on) as noted in Table 6. This leverage concept is similar to the one illustrated in Table 1 for training programs. Moreover, the selection program's leverage over 10 years is far greater than the number of programmers selected (i.e., 618 times 7, or 4,236).

Utility computation. The utility values shown at the bottom of Table 6 were calculated by computing the cost-benefit consequences for each of the ten years, and then summing them over all 10 years, adjusting for taxes, variable costs and interest rates. Comparing these values to those in Table 5 illustrates the substantial effects of re-applying the PAT as subsequent cohorts of programmers are hired. Testing costs indeed rise substantially to a discounted after-tax total of approximately $40,000. Selection benefits, however, are now $54.32 million (i.e., the after-tax, after-cost discounted sum of the productivity effects over 31,282 person-years). The difference between the $54.32 million benefit and the $40,000 cost is $54.28 million in after-tax, after-cost discounted value (compared to selecting randomly). This value is substantially greater than the $12.55 million reported in Table 3, primarily because of the increased leverage gained by re-applying the selection program. Yet, human resource decision makers seldom even compute a leverage figure, let alone trace its effects on program costs and benefits.

Dealing with uncertainty. Once again, break-even analysis can assist with uncertainty. Again, suppose there was some disagreement and uncertainty regarding the increased value per person-year produced by using the PAT. The analysis above assumed it would equal $6,331 per person-year. However, one might question the assumed validity increase of .76, or the likelihood of hiring the top 50% of applicants, or the assumption that the value of those selected remains constant over time and as new programmers are added to the work force. We can express the relationship between total utility and the increased value per person-year (symbolized QUAL) as follows:

$$\text{Utility} = (8{,}580 \times \underline{QUAL}) - \$40{,}000 \qquad (6)$$

where 8,580 equals the total benefit (i.e., $54.32 million) divided by the work force value increase (i.e., $6,331 per person-year), and reflects the 31,282 person-years of leverage as well as the financial considerations.

Applying break-even logic using this formula suggests that new-hire value per must increase by only $4.66 per person-year (i.e., $40,000/8,580) to break-even with the $40,000 discounted, after-tax testing costs. Once again, though the particular utility value of $54.28 million may be highly uncertain, break-even analysis suggests that the risk of producing an effect small enough to render the PAT a poor investment may be quite low, because the break-even necessary improvement in new-hire value is only $4.66 per person-year. At the very least, such an analysis focuses debate on the decision to be made, rather than the measurement details behind a particular utility value. Moreover, because the relationships are mathematically explicit, personal computer programs using spreadsheets or other types of software can greatly reduce computational requirements.

Utility Analysis Integrating Selection and Recruitment

Our analysis thus far has simply assumed that the same group of applicants would be considered whether the new selection system is used or not, but selection programs don't operate in a vacuum. They are affected by characteristics of the applicant pool generated through recruitment activities (Boudreau & Rynes, 1985). A stringent selection process will still yield new hires of lower value if applied to poorly-qualified applicants, and vice versa. So, the quality of new hires may be enhanced through investments in improved recruitment (such as recruiting at better-quality colleges), as well as investments in better selection. Even when recruitment activities remain the same, changes in selection activities can affect the applicant pool. For example, polygraph or drug tests might actually reduce work force quality if better-qualified applicants find them intrusive or insulting, and decide not to apply. When can changes in selection strategies actually reduce work force value through their effects on applicant pools? When are investments in improved recruitment cost effective? How can investments in recruitment and selection be integrated to create the highest combined return? Utility Model #4 (see Table 2) addresses questions like these.

<u>How The Multiple-Cohort External Recruitment and Selection Utility Model Works</u>

The quantity of person-years in the recruitment-selection utility model reflects the same flow of employees into and out of the work force as assumed in the Financial Multiple-Cohort External Selection Utility Model (Model #3 in Table 2). The costs now reflect not only selection, but also and recruitment programs applied in each year of the analysis. Finally, in this model, the quality of new hires is calculated based on the average value of applicants in the pool (the value that would be produced by a randomly-hired group of job applicants) plus the incremental value added by selecting non-randomly from that applicant pool. Whereas the utility values reflected in the three selection utility models discussed previously reflected only the difference in work force value between selecting systematically versus to randomly, the utility value calculated by this Model #4 reflects the expected work force value of those hired using the recruitment-selection system during the analysis period. This value includes not only how well employees are selected from among the applicant pool, but the value of that applicant pool is in the first place.

Insert Table 7 Here

Applying the Model to the Case Situation

The second strategic question is: "Should the recruitment program be changed to attract higher-quality applicants?" Table 7 applies the recruitment-selection utility model to estimate the returns from using the PAT in combination with one of two recruitment methods--recruitment advertising or a recruitment agency. Recruitment advertising is assumed to produce an applicant pool with diverse qualifications but a moderate average applicant value, because recruitment advertising reaches a wide audience but provides little pre-screening. The recruitment agency is assumed to produce an applicant pool with less diverse qualifications but a higher average applicant value, because the agency is expected to screen applicants before referring them to the organization.

Table 7 shows the variables that don't change as a result of recruitment (i.e., the number of new hires, tenure, number of applicants, testing costs, average test score, and financial considerations). Utility is assessed assuming the same 10-year application of the staffing program and employee flow pattern discussed earlier.

Table 7 also shows the variables affected by recruitment. Specifically, recruitment advertising costs $2,500 per hire, while the recruitment agency costs $4,450 per hire (American Management Association, 1986, Table 55). Recruitment advertising is expected to produce an applicant pool similar to the present one, so validity is .76 and $\underline{SD}_y$ is $10,413 as before. Because the recruitment agency is expected to screen applicants more carefully, there will be less variability among them, reducing validity to .60 and reducing $\underline{SD}_y$ to $8,500 per person-year.

The advantage of the recruitment agency is in identifying an applicant pool of higher quality. To reflect this advantage in Table 7, agency-recruited applicants are assumed to have an average service value of $60,000 (due to pre-screening) offset by average service costs (including higher salaries/benefits to attract and retain them) of $40,000 per person-year, producing a net applicant value for agency-recruited applicants of $20,000 per person-year. The average service value per person-year for advertising-recruited applicants is assumed to be $52,065 per person-year (lower than agency-recruited applicants due to the lack of pre-screening), and is offset by service costs of $36,445 per person-year, for a net applicant value of $15,620 per person-year (somewhat lower than for agency-recruited applicants).

Utility Computation

The expected value of each new hire is the sum of two values: (1) the value produced by selecting randomly (i.e., hiring average-value applicants) from the applicant pool, plus (2) the incremental value produced by systematic selection from that pool. Thus, the average value of those hired through advertising is equal to the average value of the advertising-generated applicants (i.e., \$52,065 - \$36,445 or \$15,620 per person-year) plus the incremental value produced by systematic selection using the PAT (i.e., .76 times .80 times \$10,413, or \$6,331 per person-year), totalling \$21,951 per person-year. The value of those hired from the agency-generated applicant pool is equal to the average value of the agency-generated applicants (i.e., \$60,000 - \$40,000 or \$20,000 per person-year) plus the incremental value produced by systematic selection using the PAT (i.e., .60 times .80 times \$8,500, or \$4,080 per person-year), totalling \$24,080 per person-year.

Once these quality levels are computed, we compute total utility precisely as before in Table 6. That is, by multiplying average new-hire quality by the number of new hires in the work force in each of the ten years, summing over the ten-year analysis period, subtracting the total selection and recruitment costs, and adjusting for the discount rate, variable costs and taxes. Note that these computations were accomplished using a personal computer with spreadsheet software programmed to reflect the mathematical relationships.

The results are shown in Table 7. The after-tax, discounted Value of Random Selection (i.e., hiring applicants of average value) from the advertising-generated applicant pool is \$141.04 million, with a recruiting cost of \$4.55 million. The after-tax, discounted Value of Random Selection (i.e., hiring applicants of average value) from the agency-generated applicant pool is higher (\$180.50 million) but the costs are also higher at \$8.10 million. The value added by testing the advertising-generated applicants is the same as before (i.e., \$54.32 million incremental benefit minus \$40,000 testing cost). However, testing the agency-generated applicant pool adds less value (because they are already pre-screened), producing incremental benefits of $35.00 million, with the same testing cost of $40,000.

Considering only selection utility, we can see that the PAT pays off under either recruiting strategy, but achieves a smaller payoff applied to agency-generated applicants than to advertising-generated applicants (i.e., $34.96 million versus $54.28 million). However, the recruitment-selection utility model shows that the agency-generated applicant pool produces a much higher average value than the advertising-generated applicant pool (i.e., $180.5 million versus $141.04 million). When the effects of recruitment and testing are integrated, the advantage of combining agency recruiting with PAT selection is clear. Selecting agency recruits with the PAT produces a total work force value of $207.45 million (i.e., $34.96 million plus $172.4 million) compared to testing advertising recruits, which produces a total work force value of $190.76 million (i.e., $54.28 million plus $136.48 million). Sacrificing some testing effectiveness for an increase in average applicant quality makes sense. By systematically integrating the cost-benefit implications of recruitment and selection decisions, the recruitment-utility model identifies the conditions that lead to this outcome. Of course, this utility model could also be used to explore other implications of the recruitment-selection relationship (Boudreau & Rynes, 1985).

Dealing With Uncertainty

Again, break-even analysis offers a method of addressing uncertainty and risk. Suppose there was some doubt that agency-recruited applicants would really average of $7,935 more service value per person-year (i.e., $60,000 minus $52,065) than those recruited through advertising. Agency recruiting costs more, agency recruits require higher service costs to attract and retain them, and the PAT is less useful when applied to agency-recruited applicants. Isn't it rather risky to switch to an agency when you don't know the true difference in value between the applicants generated by each recruitment method? One way to address this question is to determine how much higher the average net value of agency-recruited applicants would have to be in order to offset the increased recruiting and salary costs, and the reduced testing effectiveness. Recruiting through the agency instead of advertising increases recruitment costs by $3.55 million (i.e., $8.10 million minus $4.55 million) and reduces the selection test's incremental value by $19.32 million (i.e., $54.32 million minus $35.00 million), a total negative effect of $22.87 million.

The Value of Random Selection for advertising was $141.04 million with an average net applicant value of $15,620 per person-year, while the Value of Random Selection for agency recruiting was $180.50 million with an average net applicant value of $20,000 per person-year. The Value of Random Selection rose by $39.46 million (i.e., $180.5 million minus $141.04 million) when the average net applicant value rose by $4,380 (i.e., $20,000 minus $15,620) per person-year. Because all the other variables affecting the Value of Random Selection are unaffected by recruitment, we can write the formula for the Value of Random Selection as a function of the average net value per person-year in the applicant pool as follows:

$$\text{Value of Random Selection} = (9{,}009 \times \text{Net Value}) \qquad (7)$$

Where 9,009 equals the change in the Value of Random Selection--$39.46 million divided by the change in net value per person-year in the applicant pool--$4,380. If we solve this formula for the change in average net value per person-year necessary to increase the Value of Random Selection by

$22.87 million (enough to offset the negative effects of agency recruitment), we obtain $2,538 per person-year (i.e., $22.87 divided by 9,009). So, the agency-recruited applicants pool must have an average net value of $18,158 (i.e., $15,620 plus $2,538) per person-year or more to justify the more expensive agency recruiting effort. If our service costs for agency-recruited applicants rise to $40,000 per person-year, then their service value must be at least $58,158 (i.e., $40,000 plus $18,158) per person-year to offset the negative effects of agency recruitment. In the example, agency-recruited applicants had an assumed average service value of $60,000 per person-year, producing a sizable advantage for the agency recruitment method.

The complexity of the recruitment-selection utility underscores the advantages of cost-benefit analysis in permitting calculations to be computerized and in analyzing uncertainty systematically. Moreover, the sizable effects shown in Table 7 suggest that adopting an integrated approach to recruitment and selection programs may produce substantially more valuable human resource decisions.

Utility Analysis Integrating Recruitment, Selection and Employee Separations/Retentions

Integrating recruitment and selection enhances the utility model and, as we have seen, can improve staffing program decisions. However, decisions about selection and recruitment programs affect and are affected by employee separations. If improved selection produces better-qualified new hires who leave sooner than less-qualified applicants, could the increased costs of turnover nullify the advantages of improved recruitment-selection? How much should an organization invest in programs designed to retain the best performers, such as higher compensation or improved benefits? What is an "optimum" level of employee turnover, and how is it affected by recruitment/selection programs? Should investments in improved recruitment/selection be combined with investments in programs to simultaneously retain the best performers? Answers to these questions require analyzing not just the effects of employee acquisitions, but the effects of employee separations (e.g., quits, resignations, layoffs) as well. Model #5 (see Table 2) provides a framework for such analysis.

How the Financial Multiple-Cohort External Recruitment, Selection and Separation/Retention Utility Model Works

We have assumed that each hired cohort simply stays for a number of years (10 years in our example) and then leaves. This is more realistic than focusing on only the first hired cohort, but it is still a vast oversimplification of actual separation patterns. Hired employees don't actually stay together in one group, and then leave together. Rather, during each time period those leaving may include new, old, good or bad employees. HRM decisions and programs affect the pattern of separations, which in turn affects the value of the retained work force. This is true for both selection/recruitment programs and programs designed to manage employee separations more directly (Boudreau & Berger, 1985b).

Model #5 considers the effects of separations on work force value; But rather than focusing on who is lost, the model focuses on who is retained. Consider the group of job incumbents before separations (the pre-separation work force) as a pool of employees with a certain average value to the organization. When employees separate, a subset of the incumbent pool stays with the organization. If more valuable employees separate, the retained work force value is lower than the pre-separation work force value, and vice versa. Thus, we can analyze how employee separations/retentions affect work force quality by calculating the quality (i.e., average net value per person-year) of the retained work force in each time period under different assumptions about who is retained. The cost of employee separation/retentions includes the cost of the separations themselves (e.g., exit interviews or severance pay) as well as the costs of programs designed to affect the pattern of separations (e.g., retirement incentives). The quantity of person-years affected by separations/retentions is the number of employees and time periods involved in the analysis. Decisions and programs that tend to retain more valuable employees produce higher work force value, and vice versa.

To integrate employee separations/retentions with recruitment and selection, we simply consider the effects of recruitment/selection on the value of employees added to the work force, and then the effects of employee separations/retentions on the value of employees who are retained. Briefly, in any given time period, the value of the work force consists of (1) the quantity of employees retained times their average quality, plus (2) the quantity of employees added times their average quality, minus (3) the costs of acquiring the new employees (recruitment/selection costs) and releasing the separating employees (separation/retention costs). The utility model sums the work force values in each time period, adjusting for taxes, variable costs and the discount rate.

In concept, separation/retention is similar to recruitment/selection. Recruitment/selection begins with an applicant pool from which certain individuals are chosen to join the organization. Separation/retention begins with an incumbent work force from which certain individuals are retained by the organization. Such systematic retention is quite apparent in layoff or dismissal decisions, where the organization decides who leaves and who stays. The concept also applies, although perhaps less apparently, when employees do the choosing (e.g., in the case of quits or resignations). Here, those who remain are not directly "chosen," but HRM decisions (such as competitive compensation for star performers or pension rights that vest only after extended tenure) are certainly intended to manage these separations.

Application to the Case Situation

Insert Table 8 Here

The third strategic question asks: "Should the pattern of employee separations be changed to retain more of the good performers, and how much would such a change be worth?" Table 8 applies the Financial Multiple-Cohort External Recruitment Selection and Separation/Retention Utility Model (Model #5 in Table 2) to address this question (a similar application is discussed in detail in Boudreau & Berger, 1985b). The number of acquisitions and separations is still 618 and the number of programmers is still 4,404. The financial/economic considerations remain the same, and the analysis period is still 10 years.

Table 8 assumes recruitment through advertising, so the selection and recruitment parameters reflect the assumptions corresponding to recruitment advertising in Table 7. The PAT has an assumed validity of .76, and the number of applicants, standard test score, testing cost, average applicant service value, average applicant service cost, and $\underline{SD}_y$ remain the same as before. Each group of 618 acquisitions has an average value of $21,951 per person-year. This is the sum of the value of random selection (i.e., $15,620 per person-year) plus the incremental value added by systematic selection (i.e., $6,331 per person-year).

Based on a review of costing literature, Boudreau & Berger (1985b) derived a cost of $7,000 for each acquisition (reflecting such things as the $2,500 recruitment cost, relocation, orientation, and administrative activity) and $7,000 for each separation (reflecting administrative activity, outplacement assistance, exit interviews, and severance pay). Such costs are incurred regardless of the quality of the person joining or leaving. At the beginning of the analysis, we assume the work force resembles the applicant population (i.e., average yearly incumbent service value is $52,065 and average yearly incumbent service cost is $36,045 for a net value of $15,620 per person-year).

These assumptions establish all the information needed except the pattern of separations. The separation pattern determines whether the organization keeps its better or poorer performers. Table 8 analyzes four contrasting situations: (1) random selection and retention; (2) valid selection with random retention, where those retained have the same average value as the pre-separation work force; (3) valid selection while retaining the best, where those retained have an average yearly value of $2,707 greater than the pre-separation work force; and (4) valid selection while retaining the worst, where those retained have an average yearly value of $2,707 less than the pre-separation work force.

Utility Computation

The results of the four selection and retention combinations are shown at the bottom of Table 8. Though the computations required to generate these values are complex, they were computed using a LOTUS 1-2-3 spreadsheet model reflecting the algebraic logic of the acquisition and separation utility model (Boudreau, 1985). Computerization greatly reduced the calculation effort, and simplified the analysis. Under Option 1, where the organization experiences random selection (validity of zero) and random retention (zero separation effect), it will have a 10-year after-tax, after-cost discounted work force value of $200.31 million. Under Option 2, where valid selection (validity equals .76) is introduced and retentions remain random, the work force value increases to $242.10 million over ten years. Option 3 shows that if the organization has high validity and also retains the best employees (i.e., those retained are $2,707 more valuable per person-year than the per-separation work force), it will attain the highest work force value of $351.69 million. Finally, Option 4 shows that even with highly-valid selection, if the worst employees are retained (i.e., the effect of separations is to lower the average programmer value by $2,707 per person-year), producing a low 10-year work force value of $132.50 million.

The interaction between separation and acquisition patterns has some important implications. If decision makers considered only the effects of valid selection, they would expect a $41.79 million dollar increase in work force value compared to random selection (i.e., $242.10 million minus $200.31 million). However, if improved selection is combined with improved retention, an additional $109.59 million could be realized (i.e., $351.69 million minus $242.10 million). By the same token, dysfunctional retention patterns can disrupt the effects of improved selection, as illustrated by the fact that valid selection combined with retaining the worst employees produces a work force value $67.81 million <u>lower</u> than random selection and retention. While these effects are based on a specific set of assumptions, they suggest that integrating human resource programs affecting selection and retention may produce substantial organizational benefits.

Dealing with Uncertainty

The analysis in Table 8 shows that the highest value from improved selection is achieved when the best employees are retained. Work force value is \$242.10 million when the separation effect is zero, \$351.69 million when the separation effect is \$2,707 per person-year, and \$132.50 million when the separation effect is -\$2,707 per person-year. Thus, work force value changes by \$109.6 million for each change of \$2,707 in the Separation Effect. This suggests the following relationship between changes in the separation effect and total work force value:

$$\text{Work force Value} = 40{,}488 \times \text{Separation Effect} \qquad (8)$$

where 40,488 equals \$109.6 million divided by \$2,707. Simply put, every dollar increase in the difference between the average value of the retained work force and the average value of the pre-separation work force is worth \$40,488 in discounted, after-tax, after cost value over 10 years.

Suppose managers disagreed about the likely effect of improved selection on the separation pattern. If the current selection and separation pattern is random with respect to job performance, then better selection will cause better-qualified employees to be hired. However, if better-selected employees are more likely to leave (e.g., due to better job opportunities), could this reduce the value of the work force enough to offset the selection improvement? Taking the difference between the Total Work force Value for Options 1 and 2 suggests that improved selection produces an additional work force value of \$41.79 million (i.e., \$242.10 million - \$200.31 million), assuming the separation pattern remains random. Solving Equation 8 for the Separation Effect necessary to reduce Work force Utility by -\$41.79 produces a break-even Separation Effect of -\$1,032 per person-year (i.e., -$41.79 million/$40,488). As long as improved selection causes a separation pattern where the retained work force value is greater than the pre-separation work force value minus $1,032 per person-year, then improved selection will produce a higher total work force value than random selection with random retention. Thus, using Model #5 does not require that we be certain of the value of the Separation Effect. In fact, it enables us to more precisely trace the implications of our uncertainty by making more explicit the relationships between recruitment, selection and separation/retentions.

Clearly, it is not enough for recruitment to simply fill all vacancies, for selection to appear valid, or for the turnover rate to be comparable with others in the industry. It is the patterns of employee acquisitions and separations, expressed in terms of quantity, quality and cost that produces results. The integrated utility model provides a framework for considering how these patterns and relationships can produce substantial improvements in work force value and organizational performance.

Utility Analysis Integrating Internal and External Staffing Decisions

The separation-retention utility model integrates selection, recruitment and employee separations/retentions, but it still leaves an important gap--it deals with only one job. Decisions that affect selection and separation in one job often affect and are affected by how employees move between jobs within the organization. If you select and retain highly-qualified employees in lower-level jobs do they also make good promotion candidates, or does their narrow focus makes them poor performers in upper-level jobs? When is it better to select employees based on their potential to perform in higher-level jobs rather than their qualifications for entry-level jobs? If you promote your best technical performers into management, are you decreasing work force value by reducing valuable technical performance or building organizational value with strong technical managers?

External and internal staffing are closely linked. The pool of promotion candidates is partially determined by external hiring and separation. Downsizing may involve layoffs, but it also often involves some redeployment or rebalancing in job assignments by moving employees between jobs. Moreover, internal staffing is important independent of external staffing. Organizations devote substantial time and resources to promotions, demotions and transfers, even if no external staffing takes place. The final utility model (Model #6 in Table 2) presents a framework for integrating the consequences of decisions that affect not only how employees enter and leave the work force, but how they move between jobs.

How the Financial Multiple-Cohort Internal/External Recruitment, Selection, and Separation/Retention Utility Model Works

Internal staffing involves employees moving between jobs within the organization, and includes promotions, demotions and transfers (Boudreau & Berger, 1985a). Human resource planning has focused on the quantity of internal movements between jobs (Milkovich & Anderson, 1982) using Markov or other models to predict this quantity (e.g., Anderson, Milkovich & Tsui, 1981; Rosenbaum, 1984; Stewman & Konda, 1983). Such planning identifies gaps between desired and projected quantities of employees in various jobs. Some have recognized that internal movements affect the efficient allocation of labor resources (e.g., Doeringer & Piore, 1971; Thurow, 1980), but did not propose a framework for analyzing the productivity consequences of internal movements. A decision model for internal employee movements should consider the effects of internal staffing not only on the quantity of employees, but on their quality and cost as well (Boudreau, 1987b).

For jobs that receive employees, internal movement is very much like external selection, except that the "applicant pool" consists of candidates currently employed, whose characteristics will be determined in part by their current and previous work experience in the organization. Whereas external selection decisions might use test scores to predict future performance, internal selection decisions might consider seniority, performance or assessment center scores.

For jobs that supply employees, the effect of internal movements are similar to external separation/retention, except that the pattern of separations is determined by internal staffing decisions, instead of by dismissals, layoffs or quits. Internal staffing decisions usually emphasize ensuring that vacancies in the receiving job are filled with qualified candidates. Yet, as we shall see, the effects of internal movements on the jobs that supply candidates can be as serious as employee separations, and may not always be offset by improved performance in the receiving job.

In the utility model, the value of the work force in any job at a particular time is a function of: (1) the quantity times the quality of employees retained when external separations take place, plus (2) the quantity times the quality of employees added through external recruitment/selection, plus (3) the quantity times the quality of employees retained when internal separations take place (i.e., employees move out of the job into other jobs); plus (4) the quantity times the quality of employees added through internal selection; minus (5) the costs of external and internal selection and separation activities. The model establishes the value of the work force in each job at the beginning of the analysis, and then changes that value in each time period to reflect the effects of internal and external employee movements. The resulting utility value is the sum of the work force values in the jobs analyzed during the time period analyzed, adjusted for taxes, interest rates, and variable costs.

Insert Table 9 Here

Application to the Case Situation

Question #4 asks whether investing in an assessment center for internal promotions is cost-effective. Table 9 presents the results of applying the Financial Multiple-Cohort Internal/External Recruitment, Selection and Separation/Retention Utility Model to the current example. In Table 9, the external staffing variables for the Programmer job are the same as before, except that instead of 618 new hires to replace external separations, we now have 718 new hires necessary to replace the 618 separations and the 100 promotions. The financial considerations and 10-year analysis period are the same for both jobs.

For illustration, we will consider the effects of internal promotions into a Data System Manager job containing 1,000 upper-level employees, 100 of whom leave the organization each year. A promotion-from-within policy exists, and the 100 vacancies are filled by promoting 100 Programmers. Each separation from the Manager job costs $8,000, slightly higher than the $7,000 cost for Programmers, regardless of the quality of those retained. Each promotion from Programmer to Manager also costs $8,000 (including relocation, orientation and administration). Internal selection is accomplished with an assessment center, costing an average of $380 per tested applicant (Cascio & Silbey, 1979), producing a total cost of $1.44 million per year to assess all 3,786 promotion candidates.

Notice the symmetry between the external staffing variables considered in the Programmer job and the internal staffing variables considered in the Manager job. The "applicant pool" for promotions is the group of 3,786 Programmers available in each year after external separations take place (i.e., 4,404 minus 618 equals 3,786). With 3,786 applicants for 100 job openings, the organization can be quite choosy, so the average standard test score of those promoted is 2.32 SD (standard deviations) above average. This assumes that all Programmers are promotion candidates, but one could easily consider situations in which only a limited number of Programmers are eligible or tested. Performance differences are assumed to have larger consequences in the Manager job than in the Programmer job, so $\underline{SD_y}$ among promotion candidates is $11,454 (about ten percent higher than the $10,413 $\underline{SD_y}$ for Programmer applicants).

Because the Manager job involves more discretion and responsibility than the programmer job, the average service value of Programmers promoted to Manager (i.e., the value obtained with random promotions) is assumed to be ten percent higher than they produced as Programmers. Their average service cost also rises by ten percent when promoted, reflecting higher salaries. As the value of the Programmer work force is increased (through valid external selection and beneficial separations and retentions), the value of the Programmers as promotion candidates also increases. Thus, decisions that improve the Programmer work force produce an added benefit by improving promotion candidates for Manager jobs, and vice versa. The model could also reflect smaller or larger relationships between Programmer and Manager performance.

<u>Utility Computation</u>

The bottom of Table 9 shows the effects of different internal and external staffing patterns. The values shown represent the after-tax, after-cost discounted value of the Programmer and Manager work forces, summed over the 10-year analysis period. While the computations are rather complex, the mathematical utility model is explicit enough to allow them to be programmed using a personal computer with spreadsheet software. The values in Table 9 were generated using such a spreadsheet program (Boudreau, 1987a).

Option 1 depicts random external and internal staffing. Under such a system, the average value of each job's work force remains constant as internal and external movement occur, producing a total 10-year value of $249.86 million. Option 2 introduces valid external selection using the PAT with a validity of .76. The value of Programmers is enhanced, and this enhances the value of the Manager work force when the Programmers are promoted, producing a total work force value of $296.90 million. Option 3 analyzes internal staffing in the typical manner. It acknowledges the validity of the assessment center (validity equal to .35) for the Manager job, but it still assumes that promoting highly-qualified Programmers has no effect on the quality of the Programmer work force. Under these assumptions, total work force value increases to $302.51 million. Option 4 considers the possibility that promoting highly-qualified Programmers pulls high performers from the Programmers work force, reducing the average value of the retained Programmers by $625 per person-year, producing a total work force utility of $278.68 million. Though the assessment center validly predicts future job performance for Managers, if it simultaneously removes high-performing Programmers the organization would be $12.22 million better off with random internal staffing (Option 2).

This is not to suggest that assessment centers are always poor investments, but it illustrates the value of a decision framework incorporating the effects of internal staffing decisions on the jobs that supply employees as well as the jobs that receive employees. It also illustrates the limits of internal staffing models that consider only movement quantities or head count levels. Despite the fact that the quantities of employee movements were constant across the four options, substantial differences in work force value emerged. These concepts can be extended to encompass other decisions affecting internal and external employee flows, such as "make-or-buy" decisions between internal and external selection, reductions in work force size, and systems involving more than two jobs.

Dealing With Uncertainty

Model #6 represents the most integrative utility framework, encompassing both internal and external recruitment, selection and separation/retention, as well as financial investment factors. Obviously, utility values based on such a model require estimates, and such estimates may be uncertain or variable. As with the earlier utility models, break-even analysis can address such uncertainty systematically and explicitly.

For example, Table 9 showed that when assessment-center-based internal promotions cause a reduction in average Programmer value of $625 per person-year, the $5.61 million advantage of better internal selection (i.e., $302.51 million in Option #3 minus $296.90 million in Option #2) is offset by productivity losses in the Programmer job. However, the $625 figure may be uncertain or controversial. Some might argue that while assessment center selection will cause some reduction in the value of the 3,686 Programmers who remain after promotions, it would not be $625 per person-year. How much less would the productivity reduction have to be change the decision in favor of the Assessment Center?

The results of Options 3 and 4 in Table 9 suggest that the when the Programmer Promotion Effect (the difference in average value between the pre-promotion work force and the retained work force after promotions) changes from zero to -$625, the Total Work force Value changes by -$23.83 million. Therefore, every dollar change in the Programmer Promotion Effect causes a change in Total Work force Value of $38,128 (i.e., $23.83 million/625). Knowing this, we can find the Programmer Promotion Effect that would exactly offset the $5.61 million advantage of improved Programmer selection by dividing -$5.61 million by $38,128. This produces a Programmer Promotion Effect of -$147 per person-year. If promoting the highest-qualified programmers reduces the Programmer work force value by $147 per person-year or more, the total work force value would be less than $296.90 million obtained with random promotions and retentions. Addressing the controversy does not require precisely measuring the Programmer Promotion Effect, but rather determining whether it exceeds the critical value that could change the decision to adopt the assessment center (i.e., -$147 in this example). The utility model focuses the analysis on the critical question of how Assessment Center based promotions affect the programmer work force.

Summary and Implications

Summary

This chapter has illustrated how cost-benefit utility analysis models can systematically analyze the productivity effects of human resource programs. The training program application (Table 1) illustrated utility analysis for programs affecting the stock of employees. For employee flows, Models #1 through #6 in Table 2 and their application to the case study (Tables 3 through 9) showed how cost-benefit analysis can encompass not only the relatively simple case of selecting one cohort, but the integrated effects of external selection, employee separations and internal employee movements between jobs. Note that it is also possible to integrate the utility model for employee stocks with the models for employee flows.

The break-even analysis demonstrated that precise parameter measurement may be less important than commonly believed. The important task is to identify the critical values for those variables that could affect the human resource decision and systematically assess their implications for risk and uncertainty. Then, measurement effort can proceed with a definite goal. The contribution of utility analysis is its ability to make explicit the relationships linking human resource decisions to productivity-related outcomes, and to highlight the critical assumptions and areas of uncertainty for systematic analysis.

Decision Systems Are Planning Tools

Utility analysis models offer a way to summarize and integrate a large number of productivity-related consequences, that might otherwise be ignored or incorrectly evaluated. As we have seen, such summaries and integration are not limited to evaluating programs that have already been implemented. Rather, they offer a framework for planning human resource programs and activities. The way human resource decisions are planned, communicated and evaluated is likely to affect how such decisions are perceived by managers throughout the organization, and whether they are implemented. Utility analysis offers a framework that focuses explicitly and systematically on productivity-related consequences.

However, productivity-related consequences are only one consideration in human resource decisions. Several constituents must be considered by decision makers, including not only managers concerned with productivity but employees, regulatory agencies, and communities. Furthermore, organizations are never completely rational. Politics, personalities, tradition and power often determine the outcomes of decisions and programs' success or failure (Milkovich & Boudreau, 1988, Chapter 8). Still, utility analysis models summarize productivity-related outcomes, and can assist decision makers to more systematically consider the tradeoffs between productivity and other less tangible factors. Though it will never be easy to balance a potential million-dollar return against possible negative effects on employee morale, legal vulnerability or union animosity, the task may be easier when productivity consequences are better specified. At least, decision makers will be operating from a common data set that can more appropriately address important organizational concerns.

Limited Information is No Excuse for Unsystematic Decisions

Every management function operates with uncertainty, yet dollar costs and returns are routinely considered in such decisions. Believing that "people problems" are simply too uncertain to stand up to rigorous analysis provides a convenient excuse to avoid it, but the examples presented here illustrate that it can also lead to unsystematic and incorrect decisions. Moreover, such a belief may create the impression that human resource management produces only "soft" benefits to the organization.

Utility analysis encourages decision makers to identify sources of risk or uncertainty and examine their effects on decisions, rather than attempting to precisely measure every variable. Techniques such as break-even analysis and computer-assisted "what if ..." analysis are as applicable to decisions about human resources as they are to decisions about financial, marketing or operational resources. As we have seen, such techniques often clarify the nature of uncertainty and can actually enhance decisions by demonstrating that only very unlikely events could make human resource programs unprofitable.

Human Resource Decisions Are Management Decisions

Though the contributions and importance of human resource decisions are often acknowledged abstractly (as in the common statement that "our people are our most important asset"), day-to-day decisions by line and top managers often belie this sentiment. Human resource programs are often the first to be cut to reduce budgets, managers often consider only the costs of programs or employee behaviors, and the substantial leverage of human resource decisions that affect large numbers of employees and time periods is often ignored.

If there is one overwhelming message from the illustrations presented here, it is that human resource decisions can make a difference to organizational productivity, and that these decisions can be analyzed systematically and explicitly. Organizational decisions often are ultimately made by supervisors, line managers and top management. This is as true for human resources as it is for marketing, production and financial resources. If human resource professionals are to influence these managers, they must demonstrate that human resource issues can be analyzed within a management framework, and that such analysis provides essential and important information. Utility analysis models provide a starting point.

Ignoring human resource implications, or adopting convenient but faulty decision systems is a dangerous gamble that can cost millions. This is not a startling or surprising conclusion, it is a logical consequence of viewing human resource decisions within the framework of quantity, quality and cost that applies to any management decision. In many cases, simply framing human resource issues in these terms clarifies their importance and directs managers toward better decisions (Florin-Thuma & Boudreau, in press). Actual decisions will involve different assumptions from those used here for illustration, but the principles illustrated by these examples provide a useful and general decision system. A long-term integrated research program is currently underway to further enhance the utility models, develop improved decision support tools using computers, and explore how such models affect actual managerial decisions (Boudreau, Dyer & Rynes, 1986).

It is hoped that HRM decision makers will analyze and present their decisions using cost-benefit and utility concepts; communicate better with supervisors, line managers and top managers; make more effective HRM decisions; and contribute more to organizational productivity and competitiveness. Those who fail to employ these concepts may have no one but themselves to blame when supervisors, line managers and top managers continue to ignore human resource management's contribution.

References

American Management Association (1986). Hiring strategies and costs: The AMA report. New York: American Management Association.

Anderson, J. C., Milkovich, G. T. & Tsui, A. (1981). A model of intra-organizational mobility. Academy of Management Review, 6, 529-538.

Bierman, H. Jr., Bonnini, C. P., & Hausman, W. H. (1981). Quantitative analysis for business decisions. Homewood, Ill: Irwin.

Boudreau, J. W. (1983a). Economic considerations in estimating the utility of human resource productivity improvement programs. Personnel Psychology, 36, 551-557.

Boudreau, J. W. (1983b) Effects of employee flows on utility analysis of human resource productivity improvement programs. Journal of Applied Psychology, 68, 396-407.

Boudreau, J. W. (1984). Decision theory contributions to HRM research and practice. Industrial Relations. 23, 198-217.

Boudreau, J. W. (1985). EXTMOV: A spreadsheet program for quantifying external employee movement decisions. Ithaca, NY: Author.

Boudreau, J. W. (in press). Utility analysis in human resource management decisions. In M. J. Dunnette, Handbook of Industrial-Organizational Psychology (2nd ed.). In press.

Boudreau, J. W. (1987a). MOVUTIL: A spreadsheet program for analyzing the utility of internal and external employee movement. Ithaca, NY: Author.

Boudreau, J. W. (1987b). Utility analysis applied to internal and external employee movement: An integrated theoretical framework. Working paper, Center for Advanced Human Resource Studies, School of Industrial and Labor Relations, Cornell University.

Boudreau, J. W. & Berger, C. J. (1985a). Decision-theoretic utility analysis applied to external employee movement. Journal of Applied Psychology [Monograph], 70, 581-612.

Boudreau, J. W. & Berger, C. J. (1985b). Toward a model of employee movement utility. In K. M. Rowland & G. R. Ferris (Eds.), Research in personnel and human resource management (pp. 31-53). Greenwich, Conn.: JAI Press.

Boudreau, J. W., Dyer, L. D. & Rynes, S. L. (1986). Development of utility analysis models for manpower and personnel decision making, and investigation of their effects on decision processes and outcomes. U.S. Army Research Institute, Contract SFRC #MDA903-87-K-0001.

Boudreau, J. W. & Milkovich, G. T. (1988). Human resource decisions: Personal computer (PC) exercises in personnel/human resource management. Plano, TX: Business Publications, Inc.

Boudreau, J. W. & Rynes, S. L. (1985). The role of recruitment in staffing utility analysis. Journal of Applied Psychology, 70, 354-366.

Brogden, H. E. (1946a). On the interpretation of the correlation coefficient as a measure of predictive efficiency. Journal of Educational Psychology, 37, 65-76.

Brogden, H. E. (1946b). An approach to the problem of differential prediction. Psychometrika, 14, 169-182.

Brogden, H. E. (1949). When testing pays off. Personnel Psychology, 2, 171-183.

Brogden, H. E. & Taylor, E. K. (1950). The dollar criterion--Applying the cost-accounting concept to criterion construction. Personnel Psychology, 3, 133-154.

Cascio, W. F. (1987). Costing human resources: The financial impact of behavior in organizations. (2nd ed.) Boston, MA: Kent.

Cascio, W. F. & Ramos, R. (1986). Development and application of a new method for assessing job performance in behavioral/economic terms. Journal of Applied Psychology, 71, 20-28.

Cascio, W. F. & Silbey V. (1979). Utility of the assessment center as a selection device. Journal of Applied Psychology, 64, 107-118.

Cronbach, L. J. & Gleser, G. C. (1965). Psychological tests and personnel decisions (2nd ed.). Urbana, IL: University of Illinois Press.

Cronshaw, S. F. & Alexander, R. A. (1985). One answer to the demand for accountability: Selection utility as an investment decision. Organizational Behavior and Human Decision Processes, 35, 102-118.

Doeringer, P. & Piore, M. (1971). Internal labor markets and manpower analysis. Lexington, MA: Heath-Lexington.

Fitz-Enz, J. (1984). How to measure human resources management. New York: McGraw-Hill.

Flamholtz, E. (1985). Human resource accounting (2nd ed.). San Francisco, CA: Jossey-Bass.

Florin-Thuma, B. C. & Boudreau, J. W. (in press). Effects of performance feedback utility on managerial decision processes. Personnel Psychology.

Gow, J. F. (1985). Human resource managers must remember the bottom line. Personnel Journal, April, 30-32.

Hunter, J. E. & Schmidt, F. L. (1982). Fitting people to jobs: The impact of personnel selection on national productivity. In M. D. Dunnette & E. A. Fleishman (Eds.), Human performance and productivity (Vol. 1, pp. 233-284).

Landy, F. J., Farr, J. L. & Jacobs, R. R. (1982). Utility concepts in performance measurement. Organizational Behavior and Human Performance, 30, 15-40.

Mahler, W. R. (1979). Auditing PAIR. In D. Yoder & H. Heneman, Jr., ASPA handbook of personnel and industrial relations. Washington, DC: Bureau of National Affairs.

Mathieu, J. E. & Leonard, R. L., Jr. (1987). Applying utility concepts to a training program in supervisory skills: A time-based approach. Academy of Management Journal, 30, 316-335.

Milkovich, G. T. & Andersen, J. C. (1982). Career planning and development systems. In K. M. Rowland & G. R. Ferris (Eds.), Personnel management (pp. 364-388). Boston: Allyn and Bacon.

Milkovich, G. T. & Boudreau, J. W. (1988). Personnel/human resource management: A diagnostic approach. Plano, TX: Business Publications, Inc.

Naylor, J. C. & Shine, L. C. (1965). A table for determining the increase in mean criterion score obtained by using a selection device. Journal of Industrial Psychology, 3, 33-42.

Rich, J. R. & Boudreau, J. W. (1987). The effects of variability and risk on selection utility analysis: A Monte Carlo analysis and comparison. Personnel Psychology, 40, 55-84.

Rosenbaum, J. E. (1984). Career mobility in a corporate hierarchy. New York: Academic Press.

Rynes, S. L. & Boudreau, J. W. (1986). College recruiting in large organizations: Practice, evaluation and research implications. Personnel Psychology, 39, 729-757.

Sackett, P. R., Schmitt, N., Tenopyr, M. L., Kehoe, N. & Zedeck, S. (1985). Commentary on forty questions about validity generalization and meta-analysis. Personnel Psychology, 38, 697-798.

Schmidt, F. L. & Hunter, J. E. (1983). Individual differences in productivity: An empirical test of estimates derived from studies of selection procedure utility. Journal of Applied Psychology, 68, 407-414.

Schmidt, F. L., Hunter, J. E., Pearlman, K. & Hirsh, H. R. (1985). Forty questions about validity generalization and meta-analysis. Personnel Psychology, 38, 697-798.

Schmidt, F. L., Hunter, J. E., McKenzie, R. C., & Muldrow, T. W. (1979). Impact of valid selection procedures on work-force productivity. Journal of Applied Psychology, 64, 609-626.

Schmidt, F. L., Hunter, J. E. & Pearlman, K. (1982). Assessing the economic impact of personnel programs on work-force productivity. Personnel Psychology, 35, 333-347.

Sheibar, P. (1974). Personnel practices review: a personnel audit activity. Personnel Journal, March.

Stewman, S. & Konda, S. L. (1983). Careers and organizational labor markets: Demographic models of organizational behavior. American Journal of Sociology, 40, 298-321.

Taylor, H. C. & Russell, J. T. (1939). The relationship of validity coefficients to the practical effectiveness of tests in selection: Discussion and tables. Journal of Applied Psychology, 23, 565-578.

Thurow, L. (1980). Generating inequality: Mechanisms of distribution in the U.S. economy. New York: Basic Books.

Table 1. Utility and Break-Even Analysis Applied to Decisions Affecting Employee Stocks: A Training Delivery Decision.

Decision

Should training for engineers in basic production processes be delivered through: (1) Classroom-based training, with twenty half-day sessions, class sizes of 40, conducted by experienced engineering employees, training up to 40 students per year; or (2) An Audio-Video network, consisting of one broadcast studio and 10 remote conference rooms (one-way video, two-way audio), allowing up to 200 to be trained per year

	Option 1 Classroom Delivery	Option 2 Audio-Video Delivery
Costs:	$451,035 over five years (no start-up costs because system already exists).	$1,031,147 over five years (very high start-up costs).
Quantity:	Train 40 students per year	Train 200 incumbents in the first year, and 20 new hires in Years 2 through 5.

Number of Trained Employees in the Work Force (Leverage)

	Option 1	Option 2
Year 1	40	200
Year 2	80	220
Year 3	120	240
Year 4	160	260
Year 5	200	280
Totals	600	1,200

	Option 1	Option 2
Quality:	Dollar Value of the increase in productivity due to classroom training, per person-year (Symbolized P_1).	Dollar Value of the increase in productivity due to Audio-Video training, per person-year (Symbolized P_2).

Payoff Formulas

$U_1 = (600 \times P_1) - \$451,035$ $U_2 = (1,200 \times P_2) - \$1,031,147$

Break-Even Analysis

$P_1 = \$451,035/600 = \$752$ $P_2 = \$1,031,147/1,200 = \$860$

Table 1. Utility and Break-Even Analysis Applied to Decisions Affecting Employee Stocks: A Training Delivery Decision. (Concluded)

Payoff Formula for the Difference

$$U_2 - U_1 = (1{,}200 \text{ X } P_2) - (600 \text{ X } P_1) - (\$1{,}031{,}147 - \$451{,}035)$$

$$= [P_2 - (.5 \text{ X } P_1)] - \$484$$

Decision Rules

1. If both P_1 and P_2 are less than break-even, do neither program.
2. If P_1 exceeds $752, and P_2 is less than (.5 X P_1) + $484, do Option 1.
3. If P_2 exceeds $860, and P_2 is more than (.5 X P_1) + $484, do Option 2.

Table 2. Summary of Cost-Benefit Decision Models for Employee Flows

Decision Model	Added Features	Decision Addressed by the Model
Model #1: One-Cohort External Selection Utility Model (Schmidt, et al., 1979)		Deciding how to choose which external applicants should be hired in a particular time period.
Model #2: Financial One-Cohort External Selection Utility Model (Boudreau, 1983a)	Effects of taxes, interest rates, and costs of maintaining and improving employee performance.	Financial value of deciding how to choose which external applicants should be hired in a particular time period.
Model #3 Financial Multiple-Cohort External Selection Utility Model (Boudreau, 1983b)	Effects of re-applying the selection program to subsequent applicant groups.	Financial Value of deciding how to choose which external applicants should be hired in each future time period during which a selection program is applied.
Model #4 Financial Multiple-Cohort External Recruitment and Selection Utility Model (Boudreau & Rynes, 1985)	Effects of recruitment decisions on the outcomes of selection, and vice versa.	Financial value of deciding how to attract the applicant pool, as well as how to choose which external applicants should be hired in each future time period during which recruitment and selection programs are applied.
Model #5 Financial Multiple-Cohort External Recruitment, Selection, and Separation/Retention Utility Model (Boudreau & Berger, 1985).	Effects of employee separation/retention patterns on recruitment and selection, and vice versa.	Financial value of deciding how to attract the applicant pool, how to choose which external applicants should be hired, and how to manage employee separations/retentions during each future time period during which recruitment, selection and separation management programs are applied.

Table 2. Summary of Cost-Benefit Decision Models for Employee Flows (Concluded)

Decision Model	Added Features	Decision Addressed by the Model
Model #6: Financial Multiple-Cohort Internal/External Recruitment, Selection, and Separation/Retention Utility Model (Boudreau, 1987b)	Effects of recruitment, selection and separation/retention of employees moving between jobs within the organization on external staffing decisions, and vice versa.	Financial value of deciding how to attract the applicant pool, how to choose which external applicants should be hired, and how to manage employee separations/retentions from the organization; as well as how to attract, choose and manage separations when employees move between jobs within the organization, during each future time period in which internal/external recruitment, selection and separation management programs are applied.

Table 3. Situation to be Analyzed

Cost-Benefit Information	Entry-Level Computer Programmers	Upper-Level Data System Manager
Current Employment	4,404	1,000
Number Separating	618	100
Number Selected	718	0
Number Promoted	100	100

Adapted from: Schmidt, Hunter, McKenzie & Muldrow (1979) and Boudreau (1987b).

Table 4. One-Cohort External Selection Utility Model

Cost-Benefit Information	Entry-Level Computer Programmers
Current Employment	4,404
Number Separating	618
Number Selected	618
Average Tenure	9.69 years
Number of Applicants	1,236
Average Test Score	.80 SD
SD of Applicant Value ($\underline{SD}_y$)	$10,413/yr.
<u>Ability Test</u>	
Validity	.76
Testing Cost	$10/applicant
One-Cohort Utility Increase over Random Selection Without the PAT	$37.9 million

Adapted from: Schmidt, Hunter, McKenzie, & Muldrow (1979).

Table 5. Financial One-Cohort Entry-Level Selection Utility Model

Cost-Benefit Information	Entry-Level Computer Programmers
Current Employment	4,404
Number Separating	618
Number Selected	618
Average Tenure	10 years
Number of Applicants	1,236
Average Test Score	.80 SD
SD of Applicant Value (SD_y)	$10,413/yr.
Variable Costs	5%
Corporate Tax Rate	45%
Corporate Interest Rate	10%
Ability Test	
Validity	.76
Testing Cost	$10/applicant
After-Cost, After Tax, Discounted, One-Cohort Utility Increase over Random Selection Without the PAT.	$12.55 million

Adapted from: Boudreau (1983a).

Table 6. Financial Multiple-Cohort External Selection Utility Model

Cost-Benefit Information	Entry-Level Computer Programmers
Current Employment	4,404
Number Separating	618
Number Selected	618
Average Tenure	10 years
Number of Applicants	1,236
Average Test Score	.80 SD
SD of Applicant Value ($\underline{SD}_y$)	$10,413/yr.
Variable Costs	5%
Corporate Tax Rate	45%
Corporate Interest Rate	10%
Analysis Period	10 years
Test Application Period	7 years
Person-Years Affected	31,282
<u>Ability Test</u>	
Validity	.76
Testing Cost	$10/applicant
After-Cost, After Tax, Discounted Utility Increase over Random Selection Without the PAT (Millions)	Benefit - Cost $54.32 - $.04 = $54.28

Adapted from: Boudreau (1983b).

Table 7. Financial Multiple-Cohort External Recruitment and Selection Utility Model

Cost-Benefit Information	Entry-Level Computer Programmers
Current Employment	4,404
Number Separating	618
Number Selected	618
Average Tenure	10 years
Number of Applicants	1,236
Average Test Score	.80 SD
Variable Costs	5%
Corporate Tax Rate	45%
Corporate Interest Rate	10%
Test Application Period	7 years
Person-Years Affected	31,282
Analysis Period	10 years

Work force Utility Results

Staffing Variable	Recruitment Advert.	Recruitment Agency
Ability Test Validity	.76	.60
Testing Cost	$10/applicant	$10/applicant
Recruitment Cost/Hire	$ 2,500	$ 4,450
Avg. Applicant Service Value	$52,065	$60,000
Avg. Applicant Service Cost	$36,445	$40,000
Avg. Net Applicant Value	$15,620	$20,000
SD of Applicant Value (SD_y)	$10,413	$ 8,500
Value of Random Selection	$141.04	$180.50
Cost of Random Selection	-$ 4.55	-$ 8.10
Value Added by Testing	$ 54.32	$ 35.00
Cost Added by Testing	-$ 0.04	-$ .04
Total After-Tax, After-Cost Discounted Work force Value (Millions)	$190.76	$207.45

Adapted from: Boudreau & Rynes (1985).

Table 8. Financial Multiple-Cohort External Recruitment, Selection and Separation/Retention Utility Model

Cost-Benefit Information	Entry-Level Computer Programmers
Current Employment	4,404
Beginning Average Service Value	\$52,065
Beginning Average Service Cost	\$36,445
Number Separating	618
Number Selected	618
Acquisition Cost	\$7,000
Separation Cost	\$7,000
Number of Applicants	1,236
Average Applicant Service Value	\$52,065/year
Average Applicant Service Cost	\$35,445/year
Average Test Score	.80 SD
SD of Applicant Value (SD_y)	\$10,413/yr.
Testing Cost	\$10/applicant
Variable Costs	5%
Corporate Tax Rate	45%
Corporate Interest Rate	10%
Analysis Period	10 years

Work force Utility Results

Staffing Variable	Option 1	Option 2	Option 3	Option 4
Test Validity	0.00	0 .76	0 .76	0 .76
Separation Effect	\$0	\$0	\$2,707	-\$2,707
After-Tax, After-Cost Discounted Work force Value (Millions)	\$200.31	\$242.10	\$351.69	\$132.50

Adapted from: Boudreau & Berger (1985a).

Table 9. Financial Multiple-Cohort Internal/External Recruitment, Selection, and Separation/Retention Utility Model

Cost-Benefit Information	Entry-Level Computer Programmers	Upper-Level Data System Managers
Current Employment	4,404	1,000
Beginning Average Service Value	$52,065	$57,272
Beginning Average Service Cost	$36,445	$40,000
Number Separating	618	100
Number Selected	718	0
Number Promoted	100	100
Acquisition Cost	$7,000	NA
Separation Cost	$7,000	$8,000
Promotion Cost	NA	$8,000
Number of Applicants	1,436	3,786
Average Applicant Service Value	$52,065/yr.	1.10 times average Programmer value
Average Applicant Service Cost	$36,445/yr.	1.10 times average Programmer cost
Average Test Score	.80 SD	2.32 SD
SD of Applicant Value ($\underline{SD}_y$)	$10,413/yr.	$11,454/yr.
Testing Cost	$10/applicant	NA
Assessment Center Cost	NA	$1.44 million/yr.
Variable Costs	5%	5%
Corporate Tax Rate	45%	45%
Corporate Interest Rate	10%	10%
Analysis Period	10 years	10 Years

<u>Total Work force Utility Results</u>

	Options			
HRM Activity	1	2	3	4
Programmer Selection Validity	0.00	0.76	0.76	0.76
Programmer Promotion Effect	$0	$0	$0	-$625
Manager Promotion Validity	0.00	0.00	0.35	0.35
After-Cost, After-Tax, Discounted Total Work force Value (Millions)	$249.86	$296.90	$302.51	$278.68

Adapted from: Boudreau (1987b).